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The Micrometer Caliper as a Machine Shop Gauge

SOME REMINISCENSES AND IDEAS OF A WELL-KNOWN MANUFACTURER OF MEASURING TOOLS

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My first experience in a machine shop was in 1881 at Bangor, Maine. It was in a shop devoted to general saw mill work and to all sorts of jobbing. We had a great variety of fits to make, often having to bore a hub for a driving fit on a shaft that was miles away from the shop. We were not provided with hydraulic presses, screw presses or much of anything else in the line of convenience. The only way of forcing fits was with sledge hammer, driving on a wooden block. If a hub was forced part way on and stopped, it was likely to make a lot of trouble. These things led me to a strong belief that something better than the calipers we were using would be a godsend to shops of our kind. In 1885 I went to work for the Brainard Milling Machine Co. in Hyde Park, Mass., and it was there I saw the first micrometer caliper. In a conversation one day with Mr. M——— he asked if I had ever seen a micrometer, and then produced one from his kit where he had it carefully nested in some clean cotton waste. He told me it was a good tool to find odd sizes of wire with. This started me to thinking and, as my experience had not included wire work, I naturally began to associate this new magnifying gage with general machine shop work.

About a year later, I went to work for the Brown & Sharpe Mfg. Co. at Providence, R. I. Although the B. & S. Co. had been making these calipers in small sizes for fifteen years or more,

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it seemed that for general machine work they had not fully appreciated their value. One of the foremen had a two-inch micrometer that he had made himself, and said he graduated it with a monkey wrench. This caliper was the most borrowed tool I ever saw, which, of course, went to show the demand for such a tool in that shop. Several years later through one of the queer turns of fate, I found myself associated with a small manufacturing business. In the summer of 1892 or 1893 we were struggling along under a panicky business condition, a time which will be remembered by a great many. The lack of regular work at that time gave me plenty of opportunity to make plans, and then the old idea of an improved machine shop gage began to take form which resulted in the Slocomb micrometer. It seemed that there was a field for these instruments in the larger sizes. The first micrometers undertaken were the sizes between 3 inches and 8 inches. We found, however, that the market was not ready for large sizes and for this reason were forced to make the smaller ones as well.

One of our first orders came from a Cleveland dealer for four of the 1-inch size. These tools were returned about as promptly as the mail could bring them, with a long friendly letter of advice. The advice was for us to quit the manufacture of such an instrument of precision with the "horseshoe" part finished in black enamel "where it was necessary to be nicely polished." This advice was mainly valuable in showing how micrometers were regarded and what we had to contend with. First came the fellow who stated that the micrometer was too expensive, then the other fellow who stated that it led to mistakes and was not to be trusted, and lastly the party who thought it was jewelry. In designing a micrometer especially for the machine shop, the matter of durability as well as accuracy came in for a large share of attention. Then again, as these tools were intended for everyday service, a matter of finish that was not essential and added to the cost was omitted. These experiences were all gained over twenty years ago, and I view with considerable satisfaction the developments in this time. I have a whole lot of faith in a thing that is *right* winning out if it is persisted in. The importance of making work to interchangeable sizes and the wonderful growth of automobile manufacture has been responsible in a large way for the extended use of micrometers.

There was an idea common twenty years ago that if a lot of snap gages running by even sixteenths of an inch were provided, in some mysterious way all of the variations would adjust themselves naturally. What really happened was that the variations, which were the rule, were taken care of by the fit-together method, and the resulting work was not interchangeable. Looking at this subject squarely, there are a great variety of fits required, calling for a great many measurements. A running fit in a long bearing or hub usually has to have more allowance than where the bearing

or hub is short, and the same applies to tight or force fits. Soft or hard materials, thick or thin walls of hubs, rough or smooth surfaces(whether ground or lapped or rough-turned) and the general grade of work all have a bearing on the measurements. In my opinion to meet all of these conditions, the micrometer is the most satisfactory tool known when it is used as it should be. Where approximate measurements are necessary we use a steel scale and read it directly off the work. This not only shows that the work is the desired size, but it shows *how much* larger or smaller it is, which is useful information. In making a nice fit, the micrometer will do the same thing as the steel scale but with the necessary refinement. Do not lock the micrometer to some size and then use it like a snap gage. If you do, you lose three-quarters of its value.

I have not furnished a locking device for the reason that I believe it detrimental to the best use of the micrometer and that it would tend to hinder the general adoption of micrometers in the machine shop. I make a distinction between gaging and measuring. If you are inspecting—only finding out if some size is or is not correct—this gaging might answer, but in the making, where if a size is not correct (which is likely) you want to know how much stock remains, then you want to measure and not gage.

A single micrometer with one inch range will cover the range of about four thousand snap gages besides being valuable in many other ways. Some practice with micrometers is, of course, needed to get the best results, but this is easily attained, and when attained there is no more liability of making mistakes in the reading than there is in the use of the ordinary steel scale. A great help to the use of micrometer calipers is to have graduated dials on all machines adjusting screws for lathes, planers, milling machines, grinders and where fine adjustments are made. These dials should be graduated to read in thousandths inch so that cuts can be adjusted to conform with measurements as found by the micrometer. To be sure, all of these screws are not accurate to pitch, but for the small adjustments necessary the error is not enough to be troublesome. Milling machines and grinding machines have been provided with such dials almost from the first, but they are just as necessary on lathes and planers.

In making interchangeable work, one way that has been in favor for a good many years is to make a sample or model machine, then disassemble the parts and use these as models for duplicating parts. This was the only reasonable way until the advent of micrometer calipers. Today it is perfectly feasible to put all necessary dimensions on a set of drawings so that a machine can be duplicated at any time and make good fits. Besides, this plan will produce better results, because measurements are stated on drawings, but in the case of the model, measurements of the model have to be made repeatedly with the consequent chances for making errors.

As I stated before, it was difficult to sell micrometers above the two-inch size, but now there is a demand for the large sizes running as high as 36 inches, and even larger. One reason for the demand for these large calipers is that a large shaft costs a good deal of money, and it is important that the greatest care be taken in making the fits, as it costs a great deal more to spoil a large piece than a small one. In the handling of these large micrometers, it has been found a help to use a pulley, cord and weight over the machine to act as a counterweight. This arrangement effects a convenience in having the micrometer always at hand, for the weight can be adjusted slightly in excess so that the caliper stays suspended over the machine but within reach.

On first thought it might appear that micrometers should be made with more than one-inch range each. There are several objections to this plan and there is not much in favor of it. As micrometers are usually made the spindle or screw when way down overhangs about 1 1-16 inch. A greater overhang than this causes some spring when "feeling" the caliper over the work. This, of course, could be provided for by making the parts larger, but this would necessitate making them heavier which would be an objection. The shorter screw is more easily made accurate and the accuracy is more easily maintained than in a long one. In shops where a good many men are employed, a large number of calipers must be furnished, and they may as well be of different sizes. Some of the devices I have seen for making a micrometer with a two-inch range cost as much to make as two separate micrometers. Sliding anvils and attachments are a source of inaccuracy through maladjustments. In a place where extreme reliability is desired, as in micrometer calipers, it is best to have them simple without attachments and with the least possible chance for mistakes.